

highly skilled, highly paid workers in the economy of the future; and it is essential for reforming schools into institutions that will produce students who can think and solve problems.

The "double helix" of high-skill jobs and cognitively complex schooling is presented as liberatory (Berryman and Bailey 1992). But the use of computerization toward a distinctly nonliberatory end is the more likely consequence of the twinning of school and work in the emerging world capitalist economy.



Computers and the Jobs of the Future

Both conservatives and liberals argue that for the U.S. to "be number 1" in the world economy a more educated working class is needed, one that works harder *and* smarter. The claim is that then corporations will create jobs that utilize the workers' skills. These high-skill workers will be more productive than others and will therefore earn high wages. The alternative, they warn, is low skills and low wages. Schools must therefore educate "all" students to "world-class standards" so that the corporations will be competitive.

This argument is made in the report *America's Choice* by the National Center on Education and the Economy (NCEE 1990), probably the most influential piece on U.S. education since *A Nation at Risk* (fraudulently) maintained that falling school quality endangered national security. The NCEE view can be found in legislation, particularly the recently enacted Goals 2000 school reform bill; in numerous corporate education reform proposals (e.g., California Business Roundtable 1994); and various books and government reports (e.g., Carnevale and Porro 1994). It has become virtually unquestioned conventional wisdom.

The most obvious thing about this claim is that it presumes an uncontrollable and inevitable economy to which "we" must adapt. It demands that educators accept, not challenge—never mind reconstruct—the economy.

Yet two points about the emerging economy suggest that "we" should not accept it. FIRST, continual lowering of wages is already fact and not likely to turn around; SECOND, most new hires are not likely to be doing high-skill work. For U.S. workers, real wages have been declining nearly 1 percent per year for two decades, while the dispersion of the wage—the gap between high- and low-wage work—has simultaneously widened.

As Midnight Notes (1992) argues, this calculated intent of the capitalist system over the past twenty years to reduce working-class power and income around the globe has had substantial success. Its political and technical ability to move products and services rapidly around the world has weakened the capacity of working people to band together at the national level to push up or even maintain wages. Since the competition for jobs cannot be contained by national borders, wages are dropping toward the lowest levels among the competitors, even for many high-skill jobs such as computer programmer. This push is, if anything, intensifying. The North American Free Trade Agreement, for example, is organized as a one-way ratchet to continue the lowering of wages in Mexico, Canada, and the U.S. (Calvert and Kuehn 1993), to intensify what Kuehn terms "the race to the bottom." There is certainly no reason to believe that the capitalist system will create a worldwide high-wage system or that the U.S. will remain immune from wages within its borders falling to "world-class standards."

The fallacy that most jobs will be high-skill is also widely accepted. Yet even strong proponents of the claim, such as Bailey (1991), acknowledge that most new hires for at least a decade

will be filling old slots that do not require the knowledge and skills that proponents of the "high-skills" argument point to. Moreover, the labor market forecasts that project growth in the U.S. in medium- or high-skill jobs do not consider changes in the world economy that are dispersing skilled employment more widely while driving down wages. At most, the number of middle-level-skill jobs will grow slightly in the coming decade.

Even school reformers whose first interest is not in creating workers to serve the economy nonetheless buttress their reform proposals by pointing to the presumed high-skill information economy. But what are the implications of all this for schools? Lower wages coupled with continuous attacks on public services and increased class and race stratification—the actually existing U.S. conditions—strongly suggest continuation of the "savage inequalities" so eloquently described by Jonathan Kozol (1991): sharp class gradations with immiseration for many.

The way computers and paraphernalia have been distributed already indicates this (Piller 1992; Pearlman 1994; Ramirez and Bell 1994; SEDLetter 1993). Not only are rich kids more likely to have computers at school, but their schools' machines are more apt to be up to date, drive more sophisticated software, and be connected to the Internet. Most schools are barely wired—most classrooms don't have telephone jacks or the electric wiring to run more than a couple of computers. The less money a school or school district has, the less likely it will be able to ride on the information superhighway. Presuming that funding can be found for these essentials, schools still must raise money to stay on line and educate teachers in technology use: over a five-year period, the hardware is only 18 percent of the cost of using technology (Van Horn 1994).

Telecommunications corporations are eager to exploit the school market, sometimes offering to wire schools in exchange for controlling the wires that will hook the schools to the Internet and thus to corporate coffers (Coile 1994; Einstein 1994). Poor schools in particular are prey for technology profiteers such as Whittle Communications' now-defunct Channel One. Channel One provided satellite dishes, VCRs, and TV monitors to schools that agreed to force students to watch a ten-minute daily "newscast" that included two minutes of ads. Schools in poor neighborhoods or those with the lowest per student annual spending were respectively two or six times more likely to have Channel One than were schools with the wealthiest students or highest per student spending (Morgan 1993).

Health and safety issues of computer use are also most stark for poor schools. Children are more susceptible to radiation, including that from computers, and are also at risk for the same muscular and eye strains as adults (Miller 1992). Schools that can barely afford computers are least likely to shield them or purchase ergonomically correct furniture.

In sum, the savage inequalities of the past will extend into the wired savagery of the future. There is neither empirical nor theoretical reason to believe this scenario will change for the better so long as the capitalist system continues. In general, students from low-wage families and communities need more resources if they are to catch up in the kinds of skills (technical, academic, and cultural) sought for in high-wage occupations—yet they get substantially less. Why expect the capitalist system and its government to invest extra funds to develop low-income children into sophisticated problem-solving workers if the jobs don't and won't exist?

In any event, wherever the system does invest in schooling, its purpose is to intensify schoolwork by children and to prepare them for future work—while presenting this as in the students' interest. The call for students to work harder in school is as ubiquitous as the call for schools to produce high-skill workers—and usually comes from the same sources.

Computerization of schools will not contribute to "high wages" or "good jobs." The U.S. class hierarchy will not be ameliorated by computerization, but will be intensified. Indeed, computers have been a fundamental weapon in the capitalist war against the working class over the past two decades. If computer knowledge is required in the economy, it is not because of any capitalist desire for highly paid workers or any great need for highly skilled workers.

Thinking Machines for Thinking Students?

A strong claim is sometimes made that using computers and related high-tech machinery is *necessary* for a change to a mode of schooling that focuses on thinking. For example, Ramirez and Bell (1994) conclude.

It is the position of this paper that if systemic school reform in this country is to succeed it will only do so with the application of telecommunications and information technologies at the classroom level with a simultaneous focus on sustained professional development for teachers.

The argument rests on the purported necessity of computers for enabling all students to engage in higher-order thinking activities such as understanding complex ideas, solving real-world problems, and analyzing critically.

There is an irony in this claim. The emphasis on higher-order thinking in schools rests substantially on the foundation of cognitive psychology. As Noble (1989) has shown, cognitive psychology evolved in large part because the U.S. military wanted to create artificial intelligence—but it had no useful understanding of the genuine thing. The military therefore funded extensive research in cognition, research that ended up largely confirming what progressive educators and psychologists had long maintained, that humans learn actively and by constructing and modifying mental models.

The dominant psychological theories in the U.S. have been behaviorist. In the version influencing schooling, humans supposedly learned by passively accumulating isolated bits of information. In time, the bits could be shaped into successively more complex patterns. The impact, however, was that schools presumed students could not think in a given area until they had accumulated enough bits. Those who did not sufficiently grasp the bits were condemned never to do anything interesting in school. This approach still dominates curriculum, instruction, and the ubiquitous standardized tests. Cognitive psychology, however, proposes learning as a fundamentally different process. Recognizing that students think, learn by thinking, and can learn to think better or differently, it calls for a "thinking curriculum" (cf. Resnick 1987).

The irony here is that having constructed cognitive psychology in order to develop "thinking machines," the machines are now presumed indispensable for helping students learn to think. But the very existence of thinking in schools without computers shows clearly that machines are not necessary for a thinking curriculum. The reason schools haven't encouraged thinking is not because they have lacked computers, but because the system did not want thinking workers.

A softer claim for the necessity of computers is that because of the way the economy relies on computerization, only via computers will it provide access to materials and knowledge that will facilitate higher-order thinking in academic areas for many more children. Presumably, the NII

will enable access to teachers and learned people, data banks and libraries, analytical tools such as statistical packages, and other software.

Despite the absence of funds, it is claimed that teachers working in poor systems will be able to get this complex operation functioning. However, if teachers had the time, training, and support to do this, they could reorganize their classrooms for inquiry, dialogue, critical thinking, understanding, and problem-solving—with or without computers. They don't succeed for a number of reasons: too many students, lack of resources and knowledge, and standardized tests that militate against thinking. Somehow, though, the computer will be the means to make the instructional leap.

Still, the claim of the value of computers has some persuasive aspects, though with many caveats:

- The tools free up time. For example, because of calculators, rather than spend time on arithmetical drill, students can spend time on learning mathematical reasoning and problem-solving.
- Access to information is enhanced. In many schools, the library is outdated or inadequate. The cost of some information will cheapen, making it more accessible—assuming that poor schools have the money to get and stay on line. Access, however, says nothing about the nature of the materials available on line. In seeking information, whether on networks or elsewhere, one is limited by one's inquiry framework. Without a strong frame, a student will simply be buried in tons of data. Access to information means little without guidance in learning to use information—which raises questions of whose guidance for what purposes.
- Access to people is expanded. You can use the Internet to dialogue with people all over the planet. (Of course people from all over the planet may now live in your neighborhood.) Computer advocates constantly tout examples of "real" scientists talking with kids from some school, but once millions of students are on line, how many scientists will spend time sorting through hundreds of on-line requests?
- Access to some kinds of computerized tools enable students to work on sophisticated problems rather than more basic and boring ones. Working on more realistic and complex tasks, doing so in collaboration with others, proceeding at one's own pace, even having a real-world use for the results, all can help motivate students. Again, much of this does not require computers or the NII. Moreover, once the technology becomes old hat, deeper issues of the purpose for schooling will inevitably reappear for students, for whom lack of control often guarantees lack of interest (Herndon 1972).

The important issues are not ones of technology but of politics: will the funding be there? what kinds of guidance to what ends will students receive? who controls the technology? for whom will the computer ultimately be useful? Class relations that are played out in technology implementation are also implicated in technology construction. What is done with tools is not determined so much by those who use the tools as by those who construct them. Thus, the ways in which the makers design technology can largely control the structuring and solution of problems by users, to whom the control by the maker remains invisible (Madaus 1993). Computer use is then falsely promoted as a neutral yet liberatory tool.